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SUBTASK UPDATE MEMORANDUM

Task: 5.1 CRPAQS Synoptic Weather Conditions

Subtask: Weather Typing

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Synoptic weather patterns were classified into particular pattern types with the objective of assisting in describing the various fine particulate episodes experienced in the Central Valley of California. By examining the number of occurrences of the various types of synoptic patterns during the peak particulate loading months (October through February) for a five-year period (1999 through 2003), any long-term trends in the meteorology will be described and the representativeness of specific episode events (i.e., SIP design days) can be determined.

Typing Criteria

The basic premise of the classification scheme is that the synoptic scale weather characteristics, as demonstrated by the 500 mb constant pressure patterns, strongly influence the existence, distribution and duration of air pollution episodes in the California Central Valley. Five basic weather pattern types are postulated in this report:

T Troughing. Cyclonic influence, resulting in excellent mixing, deep to unlimited mixing layers and cool air advection aloft. Synoptic patterns include long wave troughs, closed lows, zonal flow and transitory short wave troughs.

PR Pacific Ridge. Eastern Pacific ridge centered off shore, producing fresh well-mixed cool air advection into the Central Valley. Flow aloft is northerly, often with a strong gradient. Situation usually follows a cyclonic event and is the initial anti-cyclonic condition.

CR Coastal Ridge. Anti-cyclonic synoptic pattern over Pacific coast, usually the central portion of a broad ridge of high pressure at the surface and aloft. Condition is often an extension inland of the eastern Pacific ridge. Situation is characterized by a stable air mass, with week pressure gradients, and a subsidence stable layer cap over the lower boundary layer. Mixing is inhibited, and regional pollutants are trapped under the cap.

IR Interior Ridge. Great Basin high pressure ridge, with the highest pressures located in the interior west. Often produces an offshore flow condition in California at the lower levels, and is most significant in the fall. The air mass is stable, usually with a strong subsidence cap over the boundary layer. Low level gradients can often be locally strong.

PT Pre Trough. The back (west) side of an interior ridge (IR), or the late (dying) stages of a costal ridging (CR) event. The air mass is still quite stable and poorly mixed, with a subsidence cap trapping pollutants in the lower boundary layer. Pressure gradient flow becomes increasingly southerly in the lower levels as cyclonic conditions approach from the west. Often the poorest mixing occurs just before cyclonic mixing begins.

Approach and Results

The daily 500 mb synoptic weather patterns, at 1200 UTC, for the five year analysis period were examined and classified into one of the five categories listed above. The analysis was accomplished using constant pressure 500 mb height maps produced by the National Weather Service (NWS). The maps were downloaded from the NWS Severe Storm Prediction Center archives and are currently stored in the T&B Systems' CRPAQS archives. In addition, surface and low level (850 mb) data from the NWS were examined on a spot basis when the 500 mb pattern was marginal or inconclusive. However, every effort was made to limit the typing procedure to the 500 mb maps in order to maintain consistency and continuity.

It was determined during the typing categorization process that the actual height of the 500 mb surface above Oakland California was often an important indicator of the type of the weather pattern in regards to ridging or troughing. As a result, the 500 mb height above Oakland for each day was also determined from the maps and documented along with the weather types.

As the typing category for each day of the analysis period was determined, the appropriate letter designation was entered into a spreadsheet tabular form in the (Types) column. In addition, the height of the 500 mb surface over Oakland was entered in the sheet (OAK 500), and expressed in tens (x10) of meters. The spreadsheet table also contains separate columns showing the year (yy), month (mm), day of the month (dd), and Julian day of the year (j.d.). The spreadsheet is available in xls electronic format as a companion document to this report. The name of the file is: WXTYPES.xls.

Additional comments concerning the weather typing process follows:

- In general, OAK 500 heights greater than about 570 (5700 m) indicated ridging conditions.

- The synoptic categories used in this analysis sometimes produced different dispersion conditions in October than in November through February. The transition from summer to winter takes place during October in the Central Valley, and summer conditions often linger through the entire month. Winter dispersion conditions may not take place until after the first rains well into November.

- The long northwest-southeast length of the Central Valley sometimes resulted in different weather regimes in the north than in the south. When this occurred, a subjective judgment was made as to the predominant regime during the 12 hour period after 1200 UTC, in the Valley area south of the California delta.

- Strong pressure gradients in the boundary layer are often associated with T and PR conditions. As a result, the potential for locally high particulate mater (pm) loading from

suspended fine particles always exists during those regimes, even though mixing and general dispersion condition are very good.

- Offshore surface pressure gradients and shallow mixing layers may be associated with strong winds in the fall. The potential for dust events are high during these periods when fields in the Valley have recently been plowed and the first winter rains have not yet occurred.

Table 1 presents a summary of the frequency of occurrence by month of the various weather types during the 5-year period of this analysis. As might be expected for the late fall and winter months, the single category with the most occurrences was the troughing (T). The T condition, along with the Pacific ridge (PR) pattern are associated with well mixed good dispersion and generally low pollution loading regimes. The possible exception in the Central Valley could be elevated pm loading in the lower boundary layer due to locally high winds. Combined, the T and PR conditions occurred 66% of the time during the period in question. Of the stable, high pollution potential conditions that occurred 34 percent of the time, the coastal ridge CR regime was the most frequent, occurring at a rate of 21 percent.

Table 1. Monthly Frequency of Wx Types for 5-year Period 1999-2003

	Oct	Nov	Dec	Jan	Feb	Totals
T	44	74	69	67	83	337
PR	28	32	40	33	25	158
CR	43	25	33	40	19	160
IR	20	6	5	11	4	46
PT	20	11	7	4	10	52